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ABSTRACT

This study presents preliminary information about how Alberta school jurisdictions are currently providing technical support to schools and administrative offices. The focus of the study is on costs, planning and management practices, and key issues. Six "case study" jurisdictions were examined in depth, and a questionnaire was used to obtain qualitative and quantitative survey data. For all other jurisdictions, a questionnaire eliciting quantitative data was distributed. Following descriptions of technical support issues and solutions in the three case study jurisdictions, overall findings are discussed in terms of planning to use technology in teaching and learning; expenditure on technology and technology services; and technical support. Needs, concerns and emerging issues related to inputs and outcomes, competition for resources, networks and Internet access, and security are then discussed. At the end of the study, best practices are briefly highlighted. Appendices include questions for jurisdictions and schools and related Alberta Education resources. (AEF)

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TECHNICAL SUPPORT PLANNING

Best Practices
For Alberta School Jurisdictions

April, 1999

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For more information, contact:

Bonnie Brooks
School Technology Task Group
Alberta Education
11160 Jasper Avenue
Edmonton, Alberta, Canada T5K 0L2
Telephone: 780–427–9001
Facsimile: 780–415–1091

To be connected toll free outside Edmonton, dial 310-0000.

The primary intended audience for this framework is:

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PROJECT DIRECTOR

Chris Farthing	Co-ordinator of Technology Services Edmonton Catholic Regional Division No. 40

RESEARCH, SURVEY DATA COLLECTION AND WRITING

Dwight Harley	Edmonton Catholic Regional Division No. 40
Terry Wendel	Wendel and Associates Consulting Inc.

CONTRIBUTORS

Peter Balding	Black Gold Regional Division No 18
Mike Cachia	Lakeland Roman Catholic Separate School District No. 150
Edna Dach	Elk Island Public Schools Regional Division No. 14
Randy Rudd	Pembina Hills Regional Division No. 7
Paul Stevenson	Horizon School Division No. 67

SCHOOL TECHNOLOGY ADVISORY COUNCIL MEMBERS DURING DEVELOPMENT

John Travers (Chair)	Alberta Education
Peter Balding	Black Gold Regional Division No. 18
Marika Bourque	Calgary School District No. 19
Bonnie Brooks	Alberta Education
George Buck	Universities Co-ordinating Council
David Burch	Alberta Home and School Councils' Association
Edna Dach	Elk Island Public Schools Regional Division No. 14
Jack Dale	Calgary School District No. 19
Peter Darby	Chinook's Edge School Division No. 73
John Darroch	Palliser Regional Division No. 26 College of Alberta School Superintendents
Dale Erickson	Alberta School Boards' Association
Chris Farthing	Edmonton Catholic Regional Division No. 40
Toni Hafso	Alberta Education
Gary Heck	Lethbridge School District No. 51
Harry Henshaw	Alberta Education
Robert Hogg	St. Albert Protestant Separate School District No. 6 The Alberta Teachers' Association
Maurice Hollingsworth	Palliser Regional Division No. 26
Judi Hunter	Calgary School District No. 19
Glen Johnson	Edmonton School District No. 7
Doug Knight	Alberta Education
Catherine Kullman	TELUS Learning Connection
Norma Nocente	Universities Co-ordinating Council
John Percevault	Grande Yellowhead Regional Division No. 35

Archie Pick	Alberta Chamber of Resources
Doug Pudwell	Medicine Hat School Division No. 76
	Association of School Business Officials of Alberta
Randy Rudd	Pembina Hills Regional Division No. 7
	College of Alberta School Superintendents
Ralph Schienbein	Elk Island Public Schools Regional Division No. 14
Jacqueline Skytt	The Alberta Teachers' Association
Ron Sohnle	Alberta Education
Gary Spence	Wolf Creek School Division No. 72
Lonnie Springer	Calgary Roman Catholic Separate School District No. 1
Mary Stephenson	Alberta Chamber of Commerce
Barbara Stevenson	Calgary School District No. 19
	The Alberta Teachers' Association
Paul Stevenson	Horizon School Division No. 67
Arwin van Voorthuizen	Alberta College of Art
	Council of Presidents of Public Colleges and Technical Institutes of Alberta

RESOURCE PERSONNEL

John Hogarth	ConsultNet
Peter Wright	University of Alberta

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EXECUTIVE SUMMARY

This study presents preliminary information about how Alberta school jurisdictions are currently providing technical support to schools and administrative offices. The focus of the study is on costs, planning and management practices, and key issues.

Technical support is defined here as "any activity relating directly to matters such as maintenance of hardware, installation and maintenance of networks, and overall planning." This includes human resources, specific school and jurisdiction functions, and the expenditure of funds from the instruction and support blocks.

The researcher examined six "case study" jurisdictions in depth. All other jurisdictions in the province were asked to complete a questionnaire and nineteen responses were received. (This second group was called the "survey group.")

These are some of the major study findings regarding costs:

- A key concept in technology planning is the total cost of ownership (considering the cost of support and deployment as well as the cost of acquisition).
- Most jurisdictions face major challenges in finding the funds needed to purchase adequate amounts and types of hardware. School boards have already fully allocated available funds to cover the cost of salaries and the acquisition of other types of instructional resources.
- There are significant variations in spending on connectivity, security and infrastructure systems (both in schools and for administrative purposes such as records management and budgeting). For example, Internet services vary in price and availability, and the age of the school buildings affects the cost involved in connecting classrooms.

These are some of the major study findings regarding the number of technical support staff a jurisdiction hires and the roles these staff are expected to play:

- School jurisdictions are using a variety of approaches to managing the installation, set-up and efficient operation of technologies in schools and jurisdiction offices.
- The technical support role often requires one person to have a wide range of fairly specialized skills. In addition, because of the fast pace of change in technology, technical support staff must constantly upgrade their knowledge and skills. Contracted services are used to supplement staff expertise, but these services are not always available or affordable.

The major challenges to schools and school jurisdictions (in addition to funding and providing qualified technical support staff) include:

- making good decisions about, as well as managing the cost of, networks and Internet access,
- providing adequate distance learning services,
- keeping computers and software up to date,
- measuring the results achieved for the dollars spent on technology, and

- maintaining the security of networks.

Study outcomes are summarized in the form of questions that school jurisdictions and schools need to answer in order to make appropriate decisions about the provision of technical support for computer systems and applications.

INTRODUCTION

BACKGROUND

This best practices project was designed to acquire information about spending on technology and the provision of technical support. Technical support is defined here as any activity relating directly to matters such as maintenance of hardware, installation and maintenance of networks, and overall planning. This includes human resources, specific school and jurisdiction functions, and the expenditure of funds from the instruction and support blocks.

Study outcomes have been summarized in the form of "Questions for School Jurisdictions and Schools." These questions are intended to provide guidance in making key decisions about the technical support of computer systems and applications.

Shared Funding. Alberta Education has long recognized the benefits to students when education programs incorporate computer technology and its specific applications. Beginning in 1984, Alberta Education provided funding on a matching basis over a three-year period to help school jurisdictions acquire and use computers in classrooms. This support was provided through the Business Education Equipment Upgrading category of the Building Quality Restoration Program (BQRP). Apple computers began to appear in schools across the province and school jurisdictions began to develop and implement policies and plans to help schools acquire hardware, provide teacher in-service and identify the results expected from expenditures on computer technology. Issues that began to arise at this time included hardware maintenance and evergreening, acceptance of technology as a learning tool, providing appropriate teacher in-service and matching provincial funding for technology in classrooms.

The MLA I-Team Report. In 1994, recognizing a need for provincial leadership in integrating computer technology, the Alberta government established an MLA Implementation Team on Business Involvement and Technology Integration. The team's March 1996 report, *Framework for Technology Integration in Education,* recommended changes that would help schools, school jurisdictions and Alberta Education make effective use of technology and technology resources in the education system. The recommendations that have a direct bearing on technology support include:

- Schools and other places of learning are equitably and appropriately equipped with modern technologies, including access to technical support to meet learning and instructional needs.
- Minimum provincial standards be set for technology (computers, networking, emerging technologies) to satisfy instructional, curricular and administrative needs.
- Classroom teachers have access to computers to improve their technology skills and to integrate technology into their teaching.
- Alberta teachers maintain their ability to apply technology skills to their teaching.

A New Shared Funding Program. In 1996, Alberta Education introduced another shared funding program to assist school jurisdictions in the technology area. School jurisdictions were required to match Technology Integration Funding (TIF) provided by Alberta Education between April 1996 and March 1998.

Technology Planning by School Jurisdictions. In February 1997, the Alberta government identified technology as a key element of its three-year plan for education. School jurisdictions are required to address the province's Goal 5: "Information technology is integrated into education to enhance student learning, and increase efficiency and flexibility of delivery." School jurisdictions are to develop local strategies for achieving the results expected for Goal 5. To a large extent, these strategies are found in the jurisdictions' technology plans.

Accountability for Technology Expenditures. Alberta Education required school jurisdictions to report how the matching technology funding was used (in their 1996/1997 Annual Education Results Report). Boards were asked to document:

- total technology integration expenditures,
- total number of modern(ized) classroom computers less than five (5) years old, and
- total number of classroom computers purchased/modernized using technology initiative funding.

In June 1998, jurisdictions were required to report this same type of information for the period ending on March 31, 1998 through Alberta Education's Management Information Reporting Schedule (MIRS) on Technology Integration Funding. MIRS also required jurisdictions to report maximum and minimum ratios of students to modern computers.

Learner Outcomes in Technology. In June 1998, the Minister of Education approved *Information and Communication Technology, Kindergarten to Grade 12: An Interim Program of Studies*. Provincial implementation of the ICT Program of Studies is targetted for September 2000.

Consequently, schools must acquire the resources needed to support this curriculum and provide appropriate in-service training for all teachers. Schools and school jurisdictions need to deploy and support technologies to enable students to achieve the learner outcomes in technology.

Need for Additional Data. Additional information is required about how schools can best deploy technology and provide technical support, including ways to:

- design and implement a technology plan consistent with provincial directions and local needs,
- measure results achieved and use them to make improvements,
- meet the support requirements for users (teachers, students and jurisdiction staff),
- assess user needs and identify appropriate solutions,
- design local area networks (LANs) and wide area networks (WANs),
- upgrade, install and maintain equipment and software, and
- anticipate expenditures (in equipment and staff) in these areas.

DESIGN OF THE STUDY

This project involved the following three steps:

1. The researchers used a questionnaire to obtain quantitative and qualitative survey data from six "case study" jurisdictions regarding levels of technical support in their learning and administrative systems and their infrastructure. Technology co-ordinators from five of these jurisdictions were interviewed.
2. The researchers used a questionnaire to elicit quantitative data from other Alberta school jurisdictions (the "survey group"). Nineteen responses were received. Key questions directed to the case study jurisdictions also were posed to the survey group.
3. The researchers analyzed quantitative and qualitative data to identify similarities and differences among the two study groups. Findings were used to develop a set of questions that jurisdictions could use to guide their decision making in the technical support area.

The comprehensive survey instrument asked for financial information and also how technology was/is used for instructional and administrative purposes, facilities management, networked systems and security access.

In reporting findings, only mean values are presented for the case study group due to the small size of the sample. The demographics of the case study group are shown in Table 1.

Jurisdiction	Number of Schools	Number of Students (FTE)	Representative Percentage of Students in Case Study Group
1 (rural-urban)	25	8,065	12.4
2 (urban)	84	32,377	49.7
3 (rural)	17	3,367	5.2
4 (rural)	6	2,000	3.1
5 (urban-rural)	39	14,507	22.2
6 (rural)	18	4,892	7.5
Mean	**31.5**	**10,868**	**N/A**

TABLE 1: DEMOGRAPHICS OF CASE STUDY JURISDICTIONS

Table 2 shows the relative size of the jurisdictions involved in the study.

Research Sample	Mean Number of Students (FTE) per Jurisdiction	Median Number of Students per Jurisdiction
Case Study Group (six jurisdictions)	10,868	N/A
Survey Group	10,342	4,032

TABLE 2: MEAN SIZE OF JURISDICTIONS INVOLVED IN THE STUDY

There were some difficulties in analyzing data from the six case study jurisdictions.

- Many had not yet completed the 1998/1999 budget; thus projections for expenditures were not available.
- Jurisdictions had not tracked their expenditures in ways that allowed them to respond fully to the questions. Because most of the software purchases originated in the schools, jurisdiction offices had difficulty tracking these expenditures.
- Another challenge arose in defining "software." Does it include library resources such as Encarta or only classroom learning tools such as Wiggleworks?

Surveys sent to all jurisdictions were forwarded electronically to the technology co-ordinators and returned through the mail. Data analysis focused on calculating the mean and the median response level for each question.

Case study participants were identified by the project director on the basis of first-hand knowledge of the jurisdictions' activities in technology. Each of these jurisdictions had been involved extensively in drafting the technology learner outcomes for Alberta Education, had created a jurisdictional technology plan, and had been innovative in the acquisition and use of software and hardware for learning and administrative purposes. In defining the case study group, the project director recognized that several other jurisdictions could equally well have been chosen.

QUESTIONS THAT GUIDED THE STUDY

This report identifies key characteristics of school jurisdictions surveyed (demographics, implementation of technology, spending on technology and support, access to the Internet). It also presents insight into the following questions:

1. How much technical support is provided to teachers and students who use technology for learning?
2. How is technology used to improve the administration of schools and school jurisdictions?
3. How much technical support is provided to those who use technology for administrative purposes?
4. What type of technical support is needed to maintain a technology infrastructure?
5. What are the best practices in each of these areas? On what basis are the best practices determined?
6. What questions should Alberta school jurisdictions and schools ask themselves about technical support planning?

CASE STUDIES: TECHNICAL SUPPORT PRACTICES IN THREE JURISDICTIONS

The following descriptions of technical support issues and solutions in Jurisdictions A, B and C are based on information obtained through interviews with the technology co-ordinators. These three jurisdictions are members of the "case study" group.

JURISDICTION A

This large urban jurisdiction has had technical support staff in the jurisdiction office for a considerable period of time. The Information Services Department, which originally reported to the superintendent of schools through the secretary-treasurer, provided wide area network connectivity services to schools. As schools began to embrace technology for learning functions, the Information Services Department provided local area network services to schools, which were individually responsible for the instructional use of computers. As educators adopted client-server technologies and purchased new financial and human resource management applications, the distinction between business and learning applications became less clear.

In 1996, the school board created a technology services group led by a co-ordinator who was directly responsible to the superintendent. The mandate of this position was to co-ordinate and manage all technology in the jurisdiction through a technology plan. Instructional technology and administrative technology were given equal emphasis. Changes in staff responsibilities were needed to deal adequately with technology planning and accountability at the system and school levels. With the decentralization of decision making, funding for technology was reorganized to cover the costs of purchasing technology, providing technical and user support, and implementing the technology plan. Funding for technology is provided from both the support block and instruction block as prescribed by Alberta Education.

With the development of a system technology plan consistent with Alberta Education's directions, Jurisdiction A began to acquire and use more technology, particularly in enterprise systems—systems where technology is linked in all facilities to perform multiple functions for multiple users. Achieving the learner outcomes in technology has become a primary focus, along with enhancing the administrative use of jurisdiction and school computing technology. Technical support staff are helping to implement new student records software, acquire new mainframe computers in the jurisdiction office, and acquire new and diverse software applications. In addition, enhanced software and hardware in the schools require technical support, both in offering in-service for end users and maintaining the systems.

Connecting schools through a wide area network posed challenges. For example, linked database applications for student records required technical support staff to offer extensive assistance to those who managed data in the schools. These people needed to be familiar with protocols, security and functions. Once again, the technical support unit needed to be revamped to address the diverse needs of the end users and to assist in ongoing maintenance of the system.

To this end, the following technical specialists were engaged:

- Site-based technicians (instruction block). Responsibilities include: set-up and connection of technology devices; basic application support; managing print queues; backups; virus protection; workstation trouble shooting; basic network trouble shooting; maintaining school-based hardware/software inventory and warranty data; servicing and performing repairs.
- Computer specialists (instruction block). Responsibilities include: managing school-based user accounts; workstation trouble shooting (PC/Mac); identifying problems with hardware or software; installing and maintaining software in computer labs and classrooms (PC/Mac); installing and maintaining PCs/Macs and peripherals; doing category 5 structured wiring (testing, installation, maintenance, provision of Internet technical support); and providing Microsoft Office application support.
- Network support specialists (instruction block). Responsibilities include: network problem resolution; remote access and control of operations; application software installation; school labs; school offices; network analysis and monitoring; maintaining software support and upgrades; software user support and training; support services to school-based local area networks; maintaining hardware and software inventories (i.e., serial numbers, license agreements, etc.); assisting in the resolution of data communications problems over the wide area network; troubleshooting school network problems to determine cause of problem (i.e., wiring, hardware, software, etc.).
- Certificated instructional technology facilitators (instruction block). Responsibilities include: working with a system team and contractors to assist in the implementation of instructional and administrative technology; arranging for and providing training for teaching staff; upgrading staff's knowledge, skills and attitudes as required for the introduction of new corporate software applications and student records; human resource systems and financial systems applications; researching appropriate training packages; developing and producing training manuals and programs to meet the needs of the jurisdiction; and evaluating and making recommendations about existing training packages. Supporting the jurisdiction's mission statement on the ethical use of technology also is a responsibility of this position.
- Instructional technology trainers (instruction block). Responsibilities include: providing training and support services to staff. Topics include instructional uses of technology; existing and future information management strategies; technology integration in the curriculum; appropriate technology for curriculum articulation efforts; the evaluation, previewing and demonstration of software; ethical use of technology; help desk services; and jurisdiction site licencing for instructional software.
- Enterprise networking specialists (support block). Responsibilities include: researching and proposing new technologies applying to the networks; project management of all network-related implementations; preparing project plans and scheduling decisions for network upgrades; planning all aspects of the jurisdiction's network technology (i.e., applications software, virus protection, disaster backup, etc.); setting standards and conventions for hardware and software used by the jurisdiction; developing technology procedures manuals in relation to jurisdiction networks; proactively managing networks using systems management software tools; and providing in-service to technical services personnel.

- Application analysts (support block). Responsibilities include: the development and deployment of applications in support of jurisdiction functions, including communications, student records, finance, human resource management, data management and electronic information exchange.

Because funding for many of these specialists must come from the instruction block, school principals need to be aware of the implications of the learner outcomes in technology for their schools and for the jurisdiction as a whole. When staff in the jurisdiction do not have a specific kind of skill or knowledge that is required, the expertise is brought in from private technology support companies. Contracted support not only provides assistance with high-level functions but also saves time.

The diverse needs of schools make it difficult to set priorities for acquiring technology and applications that maintain and enhance the enterprise network. The jurisdiction uses a committee approach to planning, along with project management tools such as the "Microsoft Solutions Framework." Principals recommend uses of instruction block funding for technology services through the superintendent. At times, technology is put on trial. Overall hardware and software purchases remain the responsibility of each school or department.

Technical support staff in Jurisdiction A rely on administrative leadership—a school board that is committed to program enhancement and alternative delivery.

JURISDICTION B

This rural/urban jurisdiction, which is relatively close to a major metropolitan area, has developed a comprehensive technology plan that highlights priorities in hardware and software acquisition and support, both in the schools and the jurisdiction office. It became apparent very quickly that ongoing support was a key issue..

For a considerable period of time, the schools were extensive Mac users, and moving to an IBM type personal computer (PC) format meant a major change for teachers and support staff. This change was made more difficult by staff perceptions. People thought that using a PC-based enterprise (spanning the entire business organization) system would require major relearning of hardware operations and the ways in which software operates on a PC. Six full-time equivalent (FTE) technology specialists were engaged to provide staff training and support for technology in the schools. A part-time trainer also was engaged to deal with hardware integration. A network technician and a software technician are part of the technology support staff. While the ratio of staff to trainer/technology support workers remains at approximately 80:1, staff seem to be receiving services that meet their needs. The jurisdiction emphasized support at the school level to ensure that administrative (e.g., School Administration Student Information—SASI, Student Information and Records System —SIRS, TurboSchool) and instructional software would be used appropriately.

Establishing a wide area network that would allow all schools to communicate through the main server in the jurisdiction office also was a priority. Funding for the carrier is now an issue; funding from the TELUS Bright Futures Foundation is no longer available, and Internet access costs are a challenge. The jurisdiction plans to provide more virtual delivery to enhance course availability and delivery options for small high schools in remote locations. Costs for real-time delivery are projected to be considerable, and funding for this service needs to come from the

instruction block. Annual line charges and Internet access fees exceed $15 per student (more than $120,000 per year across the system).

The goal of site-based professional development activities is to have staff acquire proficiency comparable to the second outcome category in Alberta Education's learner outcomes in technology, i.e., processes for productivity. There is little support for high-level skills development across a broad segment of the teaching staff. A survey was conducted in late spring of 1998 to determine overall levels of staff proficiency and priorities for staff training in the fall. There is a move to ensure that each school has one staff member who is very knowledgeable and skilled in handling network, software and hardware issues so that someone is always available when minor problems arise.

A minimal amount of contracted services are used because it is costly to have consultants travel to the schools in remote locations. Maintenance is undertaken locally and, because much of the hardware is new, warranties cover many of the problems at this point.

Technology for administrative work also is a high priority, particularly Direct Digital Control (DDC) systems for energy management, personnel management and finance (e.g., PeopleSoft), student records (e.g., SASI) and communications.

Planning for purchases and implementation involves those who are most closely associated with the use of the technology. These people help to identify issues (e.g., training, hardware support, software applications, communications protocols, access) and to determine possible solutions. Since broad-based support is considered essential for successful technology planning and implementation, technical support includes training as well as fixing software and hardware glitches.

JURISDICTION C

This small rural jurisdiction serves approximately 3500 students. It has a number of small, isolated schools that have difficulty offering a broad range of courses, particularly at the high school level.

School staff and trustees have expressed considerable interest in enhancing instruction through the use of video cameras, satellite or land lines. However, bandwidth is a major issue. Enhanced programming for students in small schools is urgently required, but a combination of distance from major urban centres and funding limitations make solutions difficult to find.

Jurisdiction C has explored alternative approaches to providing technical support. A partnership with a post-secondary institution provides the server capability for a wide area network. TELUS is the Internet service provider, and all schools are connected to each other and to the district office. Three schools and the jurisdiction office are connected by wireless technology; all other lines in the system are centrex 56K. This partnership has reduced infrastructure costs and the need for ongoing support in this area.

Software providers also are engaged to provide technical and user support for their specific packages; e.g., SIRS, SASI, Trevlac. Staff time has been allocated to provide network support and maintenance of administrative systems.

Funding for technology and accompanying support is managed by the jurisdiction office, and staff training is funded by the schools. There is now a strong movement to involve staff from the schools in jurisdiction-wide technology planning.

Major purchases of infrastructure over a three-year period have enabled the system as a whole to acquire the required technology for instructional and administrative functions. Over 75 per cent of classrooms have been connected to the Internet. During the first five months of operation of the wide area network, students accessed more than 160,000 sites. A jurisdiction research centre is being formed to bring together the sites that are most useful to students.

Software purchases have been standardized across the jurisdiction to facilitate training and support. For example, schools make extensive use of productivity packages such as Microsoft Office and a database application.

Standardizing hardware and applications has enabled the jurisdiction to reduce costs, increase user familiarity with protocols and reduce ongoing support issues. The jurisdiction has a core group of technically proficient people who can address problems as they arise. Staff turnover is low.

FINDINGS

PLANNING TO USE TECHOLOGY IN TEACHING AND LEARNING

The case study group identified these recent trends in the use of technology in teaching and learning:

- Schools are shifting from independent desktop computing to network technologies.
- There is an increased need for an "enterprise" approach to all facets of technology.
- There is a move from having a small number of teachers who specialize in using technology in teaching to having all teachers become proficient in this area.
- Students' knowledge about technology is increasing.
- Enterprise support for technology is providing "automatic" access to applications useful in the teaching and learning process or administrative and management processes.
- The infrastructure required for electronic communication and access to the Internet, intranets and extranets is increasing the complexity of technology in schools.

All six jurisdictions in the case study group have technology plans that identify outcomes related to technical support. The following technical support outcomes are common to most of the case study jurisdictions:

- enabling communication and productivity on a common platform (equity),
- obtaining connectivity to networks for computers through Alberta Education's Network Access Grant,
- connecting a robust wide area network to local area networks that support learning and administration,
- using remote control of the desktop in all facilities to provide timely and manageable service and support,
- supporting standard application configurations with appropriate training and functionality,
- replacing components on site as needed, through warranties or provision of services,
- jurisdiction-wide licencing of common applications, and
- using human and financial resources effectively and efficiently.

The case study jurisdictions determine technology planning priorities by answering these questions in sequence:

1. What are the jurisdiction's or the schools' primary learner outcomes?
2. In what ways is technology a resource for accomplishing these outcomes?
3. What human and financial resources are needed to accomplish these outcomes?
4. What hardware and software standards are required for a technology network?
5. What will we do or develop to support a technology network?

Questions 1, 2, and 3 need to be addressed before questions 4 and 5 can be answered.

A major consideration in technology planning is the total cost of ownership. This is a relatively new concept for Alberta schools and school jurisdictions. The Gartner Group defines it as "all of the human resource costs and all of the material resource costs associated with the use of technology in a learning environment." In other words, schools and school jurisdictions need to be able to measure the costs associated with teacher or staff members' time in relation to the acquisition, set-up, operation, maintenance and support of technologies in a school environment, as well as the cost of purchasing equipment.

> "PC assets are critical assets and should be managed as such throughout their life cycle and should be managed in the context of total cost of ownership. IS organizations must dispel the popular misconception that PCs are commodities, that any box or vendor will do or that price is the only differentiator. Although products have become relatively standardized, the ways in which vendors and their products will be differentiated during the next several years will have great consequences for the management of the PC asset base, cost of ownership and the ability to exploit new technologies effectively." (Goodhue, C., et al, "Keys to Procuring and Managing PC Hardware Assets", *Strategic Analysis Report*, The Gartner Group, 1995).

Ongoing costs associated with the use of technology such as maintenance, service, upgrading, and training typically disappear into regular budget accounts and therefore do not show up as real costs associated with technology use.

As shown in Figure 1, there are three dimensions of ownership of technologies: acquisition, support and deployment.

- *Acquisition* (approximately 25 per cent of total costs) refers to all the costs associated with gathering information on technology systems and purchasing those systems (including hardware, software and furnishings as well as heating, ventilation and air conditioning [HVAC] needs).
- The *support* component, also representing approximately 25 per cent of total costs, is primarily composed of human resource costs—retaining the expertise to operate or run the technology systems, including all background processes such as back-up, recovery and communication links.
- *Deployment*, which includes envisioning, planning, developing and training as well as deploying, takes up the remaining 50 per cent of the total cost. The "Futz factor," or costs associated with non-compliance or passive resistance, can be a major part of deployment costs, as are the costs associated with implementing *Information and Communication Technology, Kindergarten to Grade 12: An Interim Program of Studies*.

The focus of this study is on two components of the total cost of owning technology—acquisition and support.

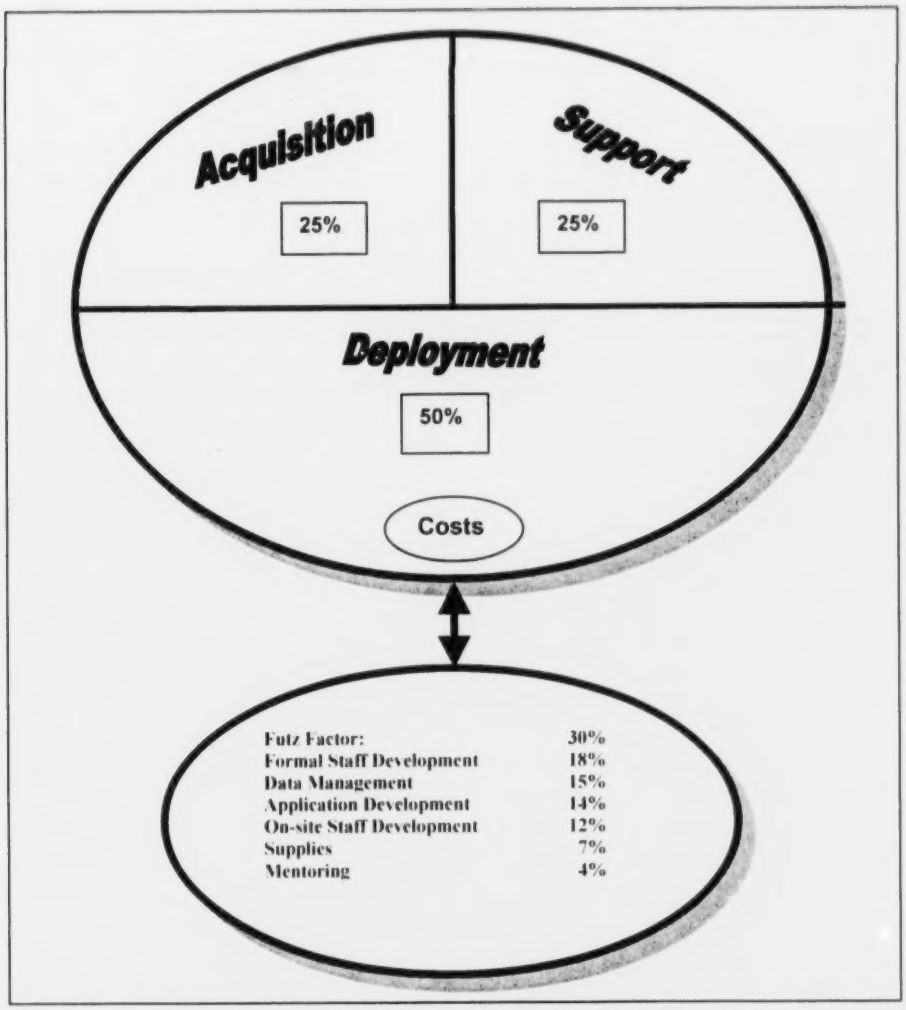

FIGURE 1: TOTAL COST OF OWNERSHIP

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QUESTIONS FOR SCHOOL JURISDICTIONS AND SCHOOLS: PLANNING TO USE TECHNOLOGY IN TEACHING AND LEARNING

Questions

School jurisdictions and schools should answer the following questions and include statements about these topics in their technology plans.

- Can we use current resources to achieve some of the provincial **learner outcomes in technology** before the provincial implementation of the ICT Program of Studies in September 2000? If so, which outcomes should we focus on?
- Can we manage the **total cost of acquiring, supporting and deploying the technology** used to achieve learner outcomes in technology and provide administrative and infrastructure support? (If we build it, can we support it?)
- Have we given equal consideration and weight to all three components of the total cost of ownership model (acquisition, support and deployment) in our vision, plans and actions?

EXPENDITURE ON TECHNOLOGY AND TECHNOLOGY SERVICES

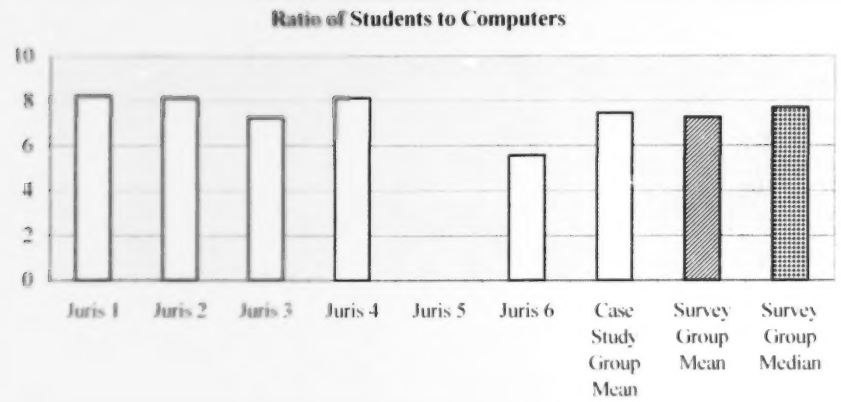
Many of the charts which follow include the median value of survey group data. A median is a point so chosen that half of the values in the data set lie above it and half lie below it. For example, the median of the set of values {1, 3, 4, 8, 9} is 4; the median of the set {1, 3, 4, 8, 9, 10} is 6.

CONTEXT

Expenditures in support of the use of information and communication technology (ICT) are influenced by many factors. Prominent among them are the use of ICT by students and the implementation and maintenance of a networked infrastructure. The following three charts speak to the potential significance of these factors by displaying the student to computer ratios and the use of the Internet by the case study and survey groups.

Ratio of Students To Computers

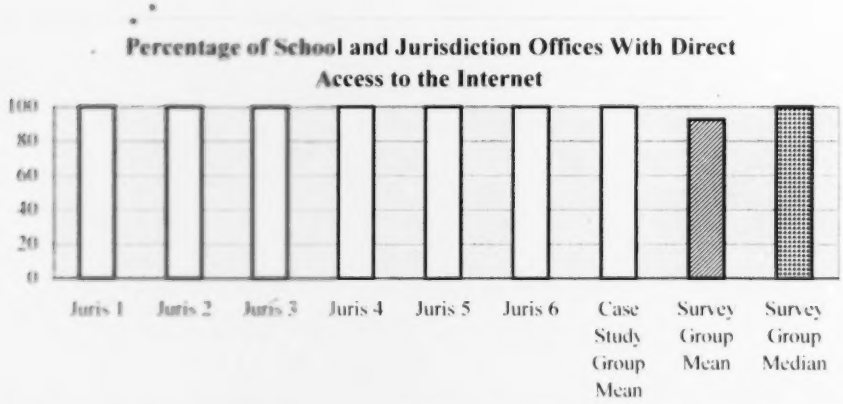
The following chart shows the ratio of students to computers at the time of this study.



In case study jurisdictions (five of six reporting), the mean ratio of students to modern computers (i.e., Apple computers with at least a 68040 processor or PCs with at least a 486-66 MHz processor) was 7.44:1; in the survey group, the ratio was 7.25:1. The results of Alberta Education's Management Information Reporting Schedule on Technology Integration Funding completed by all school jurisdictions in June 1998 indicates a provincial student to modern computer ratio of 8.59:1.

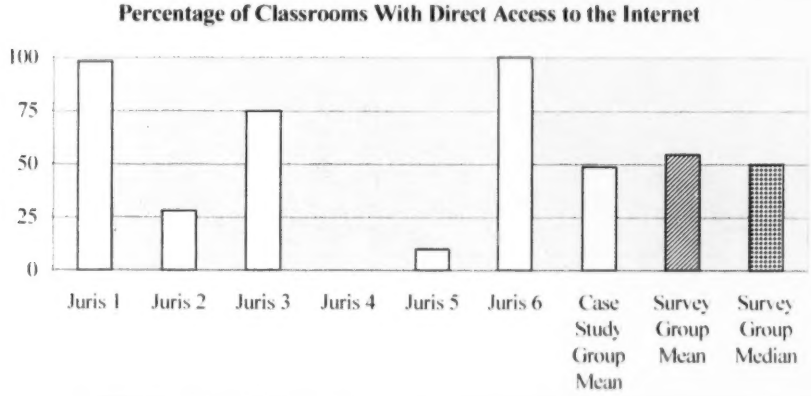
Current source documents (such as the Alberta Education Funding Manual) and the Minister of Education emphasize equity of access to computers for learning rather than an absolute student to computer ratio.

School and Jurisdiction Offices With Direct Access to the Internet



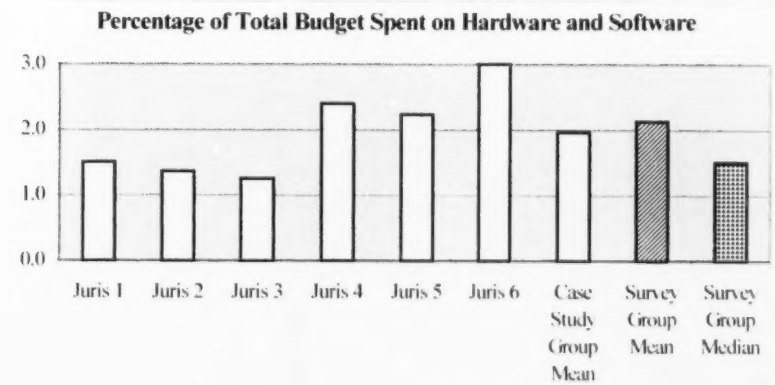
In the case study group, all schools and jurisdiction offices have direct access to the Internet. In the survey group, the mean was 92.5 per cent with a range of 33 per cent to 100 per cent. This wide range may be attributed to geography and the availability of Internet services at an acceptable cost. (Note: Alberta Education's Network Access Grant survey results in 1997 indicated that over ninety-nine per cent of schools and jurisdiction offices had established administrative Internet connections.)

Classrooms With Direct Access to the Internet



In the case study group, there was considerable variation in classroom access to the Internet. The range was from a low of zero to a high of 100 per cent, with a mean of 48.8 per cent. Results for the survey group were very similar, with a range of 0.7 per cent to 100 per cent and a mean of 54.5 per cent. Variations might be attributed to differing priorities. Also, the cost of connecting classrooms can be high in older buildings that may make non-standard systems necessary.

EXPENDITURE ON HARDWARE AND SOFTWARE



In the case study group, the mean level of expenditure on hardware and software was 1.96 per cent of the total budget, whereas this figure for the survey group was 2.13 per cent. The percentage of total budget spent on hardware and software ranged from 1.3 per cent to 3 per cent in the case study group, and from 0.5 per cent to 8 per cent in the survey group.

A number of jurisdictions in the case study group drew heavily on their capital reserves to match funds provided by Alberta Education. All six jurisdictions reported that school principals are

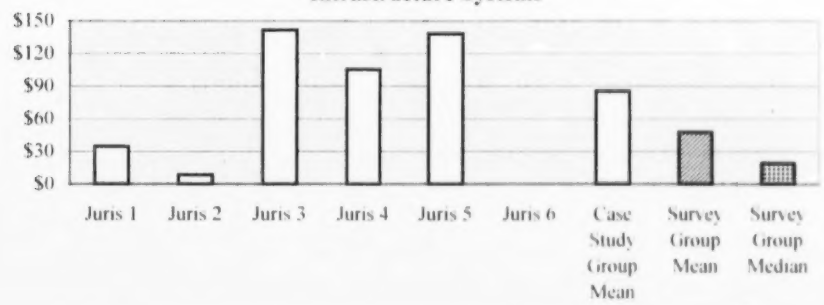
having difficulty finding enough money to cover needs in this area because most of the budget is already allocated to teachers' salaries and buying other types of instructional materials.

All of the nineteen jurisdictions included in the survey group reported that computers are used by students and teachers in classrooms, separate computer lab facilities and school libraries. Many also said that funding processes and school-based decision making may be hindering the further implementation of technology in schools.

EXPENDITURE ON INFRASTRUCTURE SYSTEMS

There were major variations among the case study jurisdictions and between the case study and survey group regarding annual cost per student for the acquisition of infrastructure. The researchers concluded that some of this variation may be the result of difficulty in clearly defining the term "infrastructure."

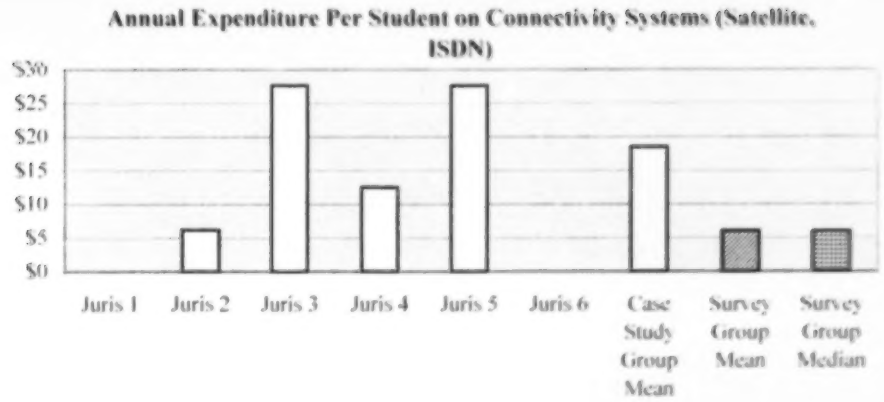
Annual Expenditure Per Student for the Acquisition of Infrastructure Systems



The mean expenditure per student in the case study group (five of six jurisdictions reporting) was $85.45 (however, three jurisdictions' heavy investments in infrastructure improvements skewed the results.) Mean cost per student for the survey group was $47.73.

The survey group also was asked to identify the expenditure per student for maintaining the infrastructure. This mean was $6.54 per student, and the range was from $0.24 to $31.42 per student.

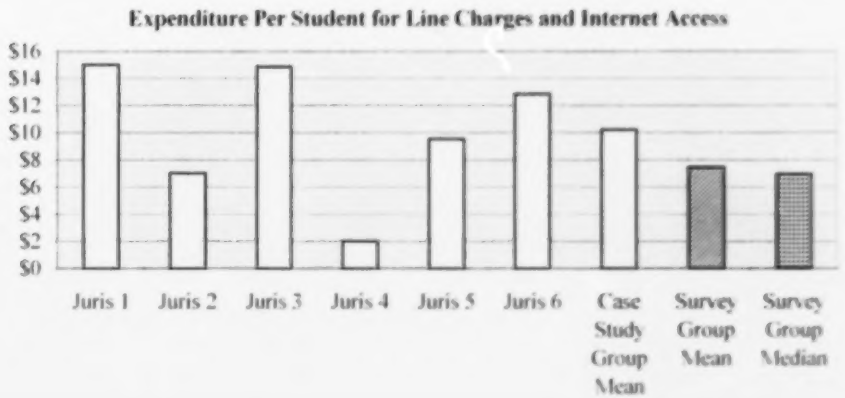
EXPENDITURE ON CONNECTIVITY SYSTEMS



Connectivity systems are systems that link schools within jurisdictions and link jurisdictions to the Internet. On average, the case study jurisdictions (four of six reporting) spent three times as much per student as the survey group ($18.46 per student versus $6.04 per student).

Further research is needed to determine what specialized connectivity equipment is being used in what environments; however, the equipment purchased likely depends on the geographic location of the jurisdiction office and schools, since the availability of services varies throughout the province. Jurisdictions reported that they select connectivity systems on the basis of what is available in their areas, and where there is choice, what is most economical.

EXPENDITURE ON LINE CHARGES AND INTERNET ACCESS



The six case study jurisdictions spend an average of nearly 30 per cent more than their counterparts in the survey group. A mean expenditure level of $10.20 per student was obtained for the case study group; for the survey group, the mean expenditure per student was $7.44. In

both groups, there is considerable variation in expenditures. The range for the case study group is from $2.00 per student to $15.00; the range for the survey group is from $0.73 per student to $27.17.

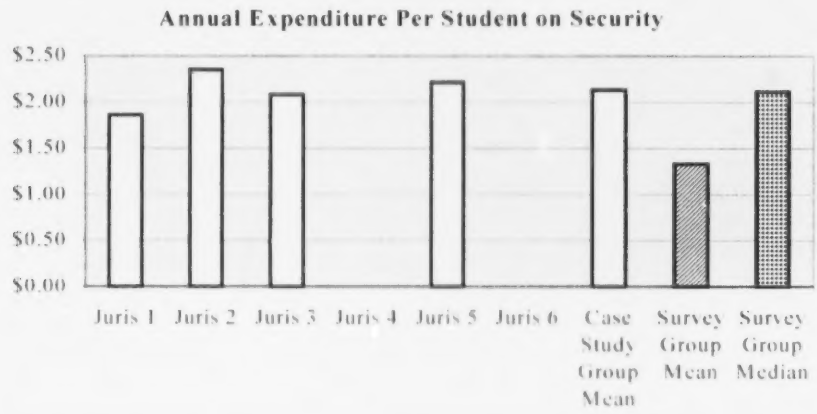
The variations likely reflect the high cost of accessing Internet services in some rural areas. One interviewee commented that low-cost Internet through the TELUS World Learning Program is no longer available and costs will rise substantially.

Supporting Internet access through in-school and jurisdictional technicians remains a priority for the case study jurisdictions. Co-ordinators commented that someone needs to be present in the school to help teachers access the Internet (software loading, protocols, security, passwords). Where jurisdiction servers exist, the problems are fewer and are mostly of a hardware nature (modems, cabling).

EXPENDITURE ON SECURITY

The term "security" refers to measures taken to ensure that technologies are protected from hackers or other individuals or systems outside their jurisdiction, and to preserve the safety and integrity of data and systems within the jurisdiction. This is an increasing concern as more computers are networked. Jurisdictions face the possibility that data and systems will be destroyed, communication systems will be interrupted and privacy will be invaded.

For further information on this topic, see *Computer Network Security: Best Practices for Alberta School Jurisdictions*.



In the case study group (four of six jurisdictions reporting), security costs varied from a low of $1.86 per student to a high of $2.35 per student. The variation in the survey group was more pronounced—from a low of zero to a high of $6.28. The mean cost for case study jurisdictions was $2.13 per student, and for the survey group this figure was $1.33 per student. Variations can be attributed to local circumstances, levels of the technology, software programs used and the number of users connected to a jurisdiction network.

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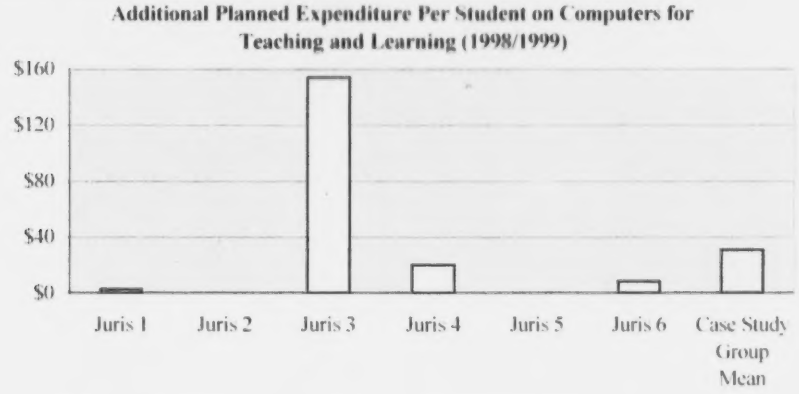
ADDITIONAL PLANNED EXPENDITURE ON COMPUTERS FOR TEACHING AND LEARNING (1998/1999)

Allocating additional funds for computers as a learning resource is a local decision made in relation to the technology plan and the jurisdiction budget.

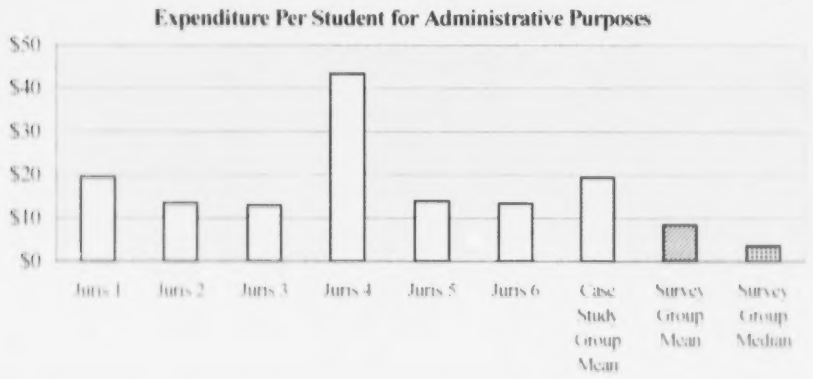


Four of the six case study jurisdictions reported that additional funds would be expended in 1998/1999 for computers to be used as learning resources. One jurisdiction planned a significant increase in expenditure, thus skewing the results.

Unfortunately, two of the six jurisdictions could not respond to this question as budget deliberations were taking place at the time of data gathering. The researchers did not pose this question to the survey group.

EXPENDITURES ASSOCIATED WITH ADMINISTRATION

"Computers used in administration" refers to the use of technology and associated applications for budgeting, student records management, networks, communications and so on.



As in other data areas, there was considerable range in these costs as local situations and priorities were substantially different. The mean cost per student for case study jurisdictions was $19.30; in the survey group, the cost per student was less than half this amount ($8.31). In the survey group, the range of expenditure was from $1.61 per student to $43.26; the case study group had a smaller range with an expenditure low of $12.77 and a high of $43.25 per student.

Table 3 shows selected technology-related expenditures by the case study group in support of jurisdiction office administration. These six jurisdictions reported that the greatest proportion of spending is for software licences (36.9 per cent) and the purchase of administrative software (28.7 per cent).

	Average Budgeted Expenditure ($)	Percentage of Budget	Average Expenditure Per Student ($)
Software Purchases	47,000	28.7	4.32
Software Licences	60,500	36.9	5.57
Backup	39,333	24.0	3.62
Disaster Recovery	11,916	7.3	1.10
Training, Maintenance, etc.	5,000	3.1	0.46

TABLE 3: TECHNOLOGY COSTS ASSOCIATED WITH ADMINISTRATION (CASE STUDY GROUP)

A number of case study jurisdictions are purchasing or recently purchased significant infrastructure hardware/software that requires support, not only in set-up but in continued operation for the first year. The supplier would normally provide warranty work for one year but in-service and problem solving when glitches occur also need to be addressed quickly or even anticipated so that users remain "engaged." A systems analyst could provide excellent advice about difficulties experienced in prior installations; this knowledge could well make the difference in a successful implementation.

Additional research is needed to identify standard hardware and software configurations that could be used effectively in rural and urban jurisdictions.

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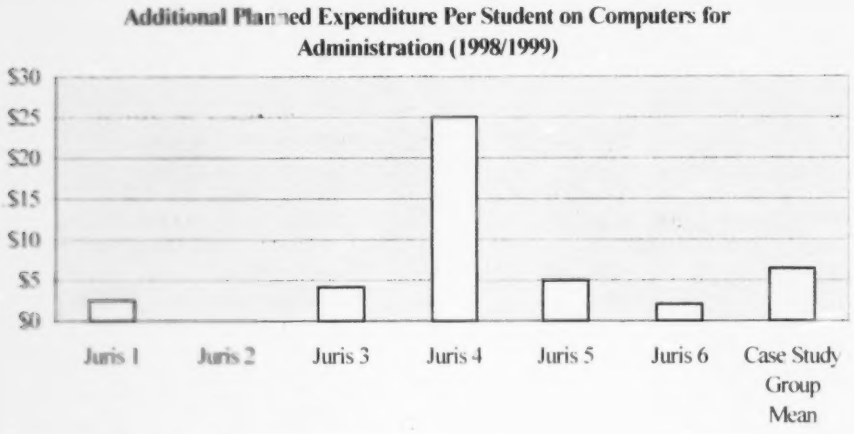
ADDITIONAL PLANNED EXPENDITURE ON COMPUTERS FOR ADMINISTRATION (1998/1999)



Funding increases for computers as an administrative resource are planned in five of the six case study jurisdictions. One of the case study jurisdictions is implementing a new system to assist with student records, management, budgeting and communications. Generally, the increase is approximately 20 per cent of the amount planned for computers as a learning resource. The mean expenditure increase is $6.44 per student.

The survey group was not asked to respond to this question.

AREAS FOR FURTHER RESEARCH

Additional research is needed to address issues raised by the data in this section. For example:

- Identifying the hardware and software configurations most commonly used in the province for administration would help school jurisdictions to purchase in quantity against identified standards.
- Identifying the specialized equipment used in different geographic zones would assist in instructional delivery and networking of services.
- Identifying the minimum network configurations and standards that provide adequate technology service to schools and jurisdictions would be useful.

The Gartner Group (1998) states that network and systems management technology's effectiveness in reducing costs is often limited by the complexity of the structure and by the methods of management already established. The more complex the technology environments, the higher the costs to support and maintain them. Simplicity in systems purchased and installed leads to lower costs in supporting and maintaining technologies.

Software accounts for the majority of the complexity in information technology systems (65 per cent).

The complexity of software is the result of:

- the percentage of software applications that are client/server (split application logic),
- the number of programming languages used by all client/server applications,
- the average length of time that the client/server applications have been installed,
- the percentage of applications that are:
  - "enterprise critical" (applications that impact the necessary operations of multiple departments such as sales or human resources)
  - "workgroup critical" (multi-user applications used within one department or workgroup, such as line-of-business-specific applications)
  - for "personal productivity" (software such as spreadsheets or word processing used by individuals),
- the number of overall database management system platforms that are used by all client/server applications,
- the number of distinct protocols used by all client/server applications, and
- the total number of operating system platforms in use (servers and desktops).

The complexity of hardware is the result of:

- the total number of distinct hardware platforms in use,
- the "technology refresh rate," that is, the percentage of PC/workstations (quantity, rather than cost) replaced/upgraded within the last twelve months,
- system redundancy provisions; e.g., percentage of servers, hubs and routers with redundant elements, and
- total mobile units (percentage of user devices that are portable or mobile).

QUESTIONS FOR SCHOOL JURISDICTIONS AND SCHOOLS: THE COST OF TECHNOLOGY

Questions

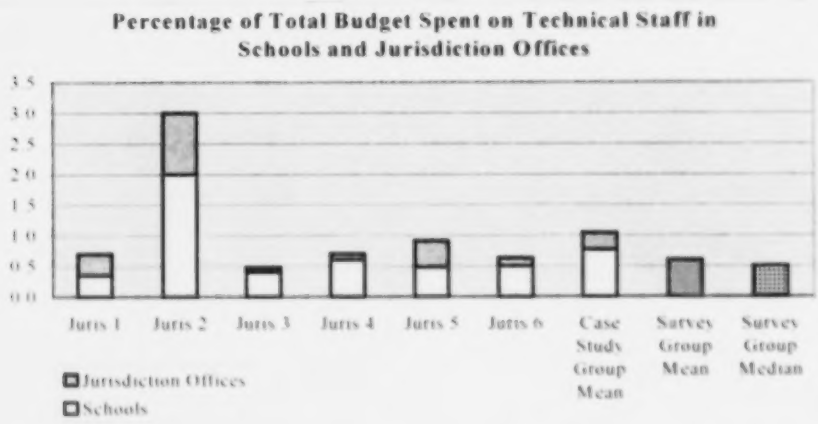
School jurisdictions and schools should answer the following questions and include statements about these topics in their technology plans.

- ❑ What percentage of the total jurisdiction budget will we spend on **hardware and software**? (Should it be 2 per cent, as in the case study group for this research project?)
- ❑ How will we handle **decision making** about the deployment of technology (school-based budgeting, jurisdiction office policies, a combination of both)?
- ❑ Has our jurisdiction clearly defined "infrastructure" so that expenditures on **infrastructure** can be more accurately recorded?
- ❑ Can our jurisdiction link with others to develop procurement and service standards and provide adequate **connectivity levels** at affordable rates?
- ❑ How much will we spend on **security**? Should the amount be $2.25 to $3.00 per student—slightly above the current mean for the sample of Alberta jurisdictions studied in this research project?
- ❑ What steps will our jurisdiction take to increase **classroom access to the Internet** (which is essential for achieving provincial learner outcomes in technology)?
- ❑ What steps will our jurisdiction take to expand **access to the Internet for schools and jurisdiction offices** (something that all or most of the jurisdictions surveyed in this study consider essential)?
- ❑ How does our jurisdiction's **ratio of students to computers** compare with the means reported in this study and with the Management Information Reporting Schedule results from across the province? What should our targets be in this area, and how will we budget for the acquisition of additional hardware?
- ❑ What amount will our jurisdiction need to budget for in order to provide Internet **access** and cover **line charges**?
- ❑ How will we provide **technical support for Internet access**?
- ❑ Should our jurisdiction allocate **additional funds for purchasing computers as a learning resource**? If so, where will we find the necessary funds?
- ❑ Should our jurisdiction allocate **additional funds for purchasing computers as an administrative resource**? If so, how should this allocation compare to the expenditures on computers as a learning resource? Where will we find the necessary funds?

TECHNICAL SUPPORT

Technical support is the provision of human resource and contract services to provide for the installation, set-up and efficient operation of technologies in schools and jurisdiction offices.

EXPENDITURE ON TECHNICAL STAFF IN SCHOOLS AND JURISDICTION OFFICES



Generally, jurisdictions spend nearly three times as much on school-related technical staff as on jurisdiction-office-related technical staff. This trend reflects the current emphasis on delivering instruction that achieves the provincial learner outcomes in technology. It also may reflect the fact that jurisdiction offices can more efficiently use contract services because many computers and systems are located at one site. However, the respondents did not all use the same criteria in reporting their expenditures. The total expenditure on technical support staff as a percentage of total budget was 40 per cent lower in the survey group than in the case study group.

RATIO OF JURISDICTION OFFICE TECHNICAL SUPPORT STAFF TO STUDENTS

Typically, jurisdiction office technical staff manage "enterprise" technologies such as wide area networks, communications and Internet access and corporate information systems. School-based technical staff are more involved with desktop applications and school-based learning systems. The following chart shows the ratio of jurisdiction office technical support staff per thousand students for the case study group.

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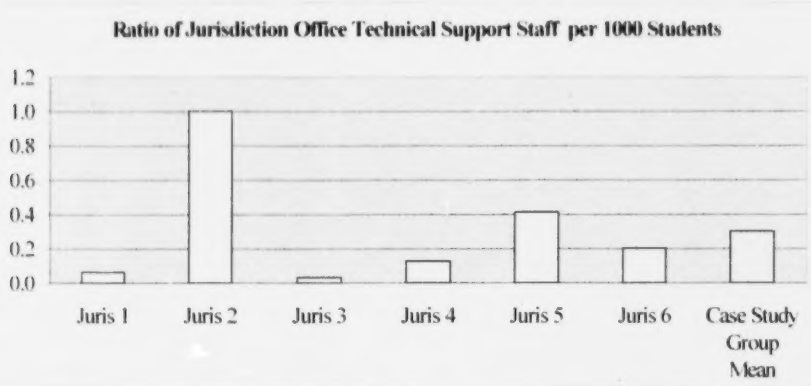
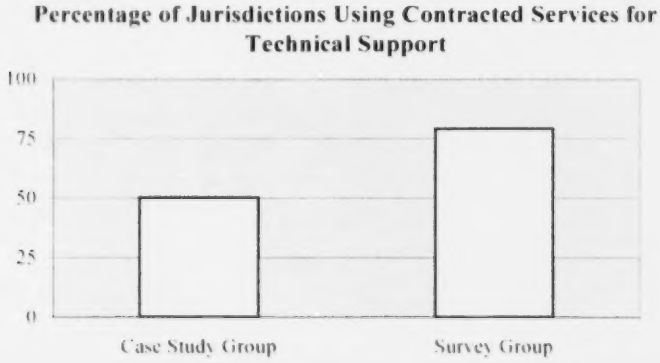


Ratios vary considerably among the jurisdictions in relation to the level of sophistication of hardware and software, the nature and number of workstations, the uses of software and the programming languages used. In the case study group, ratios ranged from 0.03 per 1000 students to 1.0. Clearly, circumstances unique to each jurisdiction require unique solutions. Jurisdiction 2, for example, is investing heavily in a new computer system for student records and network management. This question was not posed to the survey group.

In the case study jurisdictions, jurisdiction office technical staff are deployed in a variety of ways. In smaller jurisdictions, where one or two technicians manage and support all facets of technology, there is a concern about the overwhelming amount of knowledge and skill required.

CONTRACTING TECHNOLOGY SUPPORT SERVICES AND COSTS



In the case study group, 50 per cent of respondents reported using contracted services. This figure was 80 per cent in the survey group. Some jurisdictions likely need assistance with increasingly complex technology; others may not have people on staff who can handle the installation and maintenance of hardware and software or both. In the case study group, the average cost of contract services was $61.00 per hour.

SUPPORT FOR INFRASTRUCTURE

The fast pace of change in technology poses many challenges for technical support staff, who must struggle with a vast array of decisions when installing or maintaining networks, computers and software. Table 4 shows the number of FTE staff used by jurisdictions in the case study group to support technology.

Jurisdiction	Number of FTE Staff Whose Primary Role Is to Support Infrastructure
1	15
2	10
3	2
4	1
5	N/A
6	1

TABLE 4: SUPPORT FOR THE INFRASTRUCTURE

Table 5 lists common roles of technical staff.

Role	Number of Case Study Jurisdictions That Employ This Type of Specialist (N=5)
Network Technician	5
General Computer Support	3
Software Technician	1
Installing Software and Hardware	1
Internet Access and E-Mail Support	1
Support for Educational Information Exchange (EIE)	1

TABLE 5: TECHNICAL SUPPORT SPECIALISTS IN THE CASE STUDY GROUP

The following comments were made in interviews with technology co-ordinators in the case study jurisdictions.

Standards. Two jurisdictions reported that they have implemented hardware and software standards.

Data Protection. One rural jurisdiction protects data on a computer-by-computer basis. They use tape drives as the small size of schools does not warrant mirrored hard drives. One jurisdiction uses both tape drives and mirrored drives; another uses a jurisdiction filing system to store its data and routinely back up the jurisdiction server.

Internet Access and Security. Three jurisdictions connect to the Internet via TELUS. Another is in the process of selecting an Internet service provider. In rural Alberta, the number of providers and the quality of service available are limited.

Network Access and Security. For the most part, only network technicians have unlimited access to the network. Staff members have access to jurisdiction files that are so designated by the technician. At the school level, the principal and technical support staff member have full access to the school's files. Teachers have access to their own student data.

Maintenance. Some jurisdictions contract maintenance and care of their technology to third parties.

Contracted Services. Jurisdictions have contracted with outside sources to provide network support, design web pages, repair hardware and software, develop forms and data reports, provide in-service to staff and support a mainframe computer. One jurisdiction identified two criteria when choosing to hire contractors: expertise lacking in the jurisdiction or a short-term resource crunch. Typically, this jurisdiction hires contractors for high-level troubleshooting or to handle high-end connectivity issues such as wide area networks and communication servers.

QUESTIONS FOR SCHOOL JURISDICTIONS AND SCHOOLS: TECHNICAL SUPPORT

Questions

School jurisdictions and schools should answer the following questions and include statements about these topics in their technology plans.

- How many **technical support staff** does our jurisdiction need in the schools? In the jurisdiction office? How much staff time should be allocated to each area in relation to the jurisdiction's priorities? Where will the funding come from to meet this goal?
- Has our jurisdiction planned how to cover the cost of providing **technical support for new hardware and software used in administration**? How much money should our jurisdiction allocate for technical support of administrative hardware and software? Should this amount be $25 to $30 per student, which is a typical level of funding in some jurisdictions in Alberta now?
- Do we have sufficient resources to respond quickly when **glitches in administrative hardware and software** occur? Or can we even anticipate and avoid them?
- Should we **contact other school jurisdictions and/or technology consultants** before making decisions about purchasing administrative hardware and software?

NEEDS, CONCERNS AND EMERGING ISSUES

Survey respondents were asked to name the aspects of technical support that Alberta jurisdictions most need help with. They identified these needs and concerns relating to technical support:

- accessing higher bandwidth telecommunication services,
- hiring more technical support staff,
- funding technical support,
- storing information in libraries (moving from paper to electronic storage),
- delivering distance learning using technology (especially in small schools),
- improving Educational Information Exchange,
- improving document imaging and management, and
- finding resources to "evergreen" computers.

INPUTS AND OUTCOMES

Data obtained from case study jurisdictions focusses on input (expenditures), not outcomes achieved. The only data obtained that can be used as a benchmark to determine progress is the ratio of students to computers (also input data). The impact on student learning of having achieved a ratio of 7.44 computers per student (as evidenced by the survey group) has not been measured.

A review of the literature would be useful in determining how technology improves student achievement in demonstrable, measurable ways. Information about best practices in Canada and the United States also would be useful. Consideration should be given to replicating studies on improving student achievement through the use of technology in Alberta.

The technology plans of case study jurisdictions include goals for the acquisition and use of technology for instructional and administrative purposes. An emphasis on staff training also is common to all plans. However, the plans do not include determining how student achievement and employability skills have increased with the use of technology. For example, jurisdictions might consider what technology knowledge, skills and attitudes produce the greatest employability results; e.g., Computer Aided Design and Drafting (CADD); Computer Aided Manufacturing (CAM), productivity tools.

Most importantly in terms of the scope of this report, jurisdictions could ask how teaching, support and administrative staff regard the effectiveness of technical support staff and services. In what areas is support the strongest? In what areas do staff members require additional support?

We still do not know enough about what constitutes "best practices" in technical support. What practices have the most profound effect:

- on learning outcomes for students,
- for users in administrative capacities, and
- for the infrastructure that supports both learning and administrative technologies?

COMPETITION FOR RESOURCES

Case study jurisdictions reported fiscal challenges in acquiring technology, software, training and infrastructure. There are competing priorities. For example, increased teacher salaries and smaller pupil-teacher ratios leave less funding available for technology.

Survey respondents reported significant difficulty in finding funds to match those provided by provincial TIF. There were essentially two choices—using capital reserves or reducing other expenditures at the school level. As of April 1998, school jurisdictions were no longer required to match funds made available through TIF.

NETWORKS AND INTERNET ACCESS

Jurisdictions are seeking new alternatives for Internet access though wide and local area networks. Rural jurisdictions that benefited from TELUS' low initial rate are concerned about increasing costs now that the special service is ending.

Technology co-ordinators expressed a need for a list of various network configurations and associated hardware and software that jurisdictions can use in developing their own systems. They also would like to have suggested standards for network configurations, although the rapid changes in technology make this difficult. The cost of maintaining networks in rural jurisdictions and access to qualified technical assistance are seen as barriers that need to be addressed.

SECURITY

Computer security systems that facilitate or bar access to electronic information vary in sophistication. Generally, jurisdiction offices have carefully determined access levels on the basis of the staff job descriptions. The general rule is "need to know," especially for administrative purposes. In schools, secretaries have access to financial and student data on files that are password protected. Similarly, teachers have access to student achievement and attendance data for students in their own classrooms. In schools where a server contains administrative and student achievement data, teachers are restricted to specific files that pertain only to their individual situation.

Where local and wide area networks do not exist, teachers generally use computers in their own classrooms to record attendance and achievement data, and file access is always password protected. This is of significant importance when students use the same computer as teachers.

Security is currently based on three key principles:

- access on a "need-to-know" basis,
- situational imperatives; e.g., use of LAN, WAN or stand-alone computers for administrative and/or instructional purposes, and
- who needs to communicate with whom and for what reasons.

CONCLUDING COMMENTS

Provincial funding initiatives have enabled schools in Alberta to purchase hardware and software. The learner outcomes in technology have provided a framework for applying technology in the learning environment. Support for technology in education has been left to the ingenuity and creativity of the jurisdictions and their schools, and many jurisdictions have stepped up to this challenge. At the same time, there is still much to be learned about providing technical support for the use of technology in teaching and learning environments.

Future challenges in technical support include:

- developing standards that jurisdictions and schools can use in acquiring, using and supporting technology, and enhancing the competency levels of teaching and support staff in the use of technology for learning, managing instruction and administration, and
- determining the best ways to marry various technologies (hardware and software) to maximize effectiveness and efficiency in instruction and administration.

BEST PRACTICES

Processes. All technology co-ordinators in the case study jurisdictions had formally established committees to provide advice about technology purchases, budgeting and short- and long-term planning. Broad-based support was viewed as essential prior to making any decisions and expending funds, especially since school principals allocate funds that help to achieve the goals of the jurisdiction technology plan.

Administrative Use of Technology. There is strong evidence to support the adoption of more highly sophisticated technology and software applications for administrative support purposes. However, there are difficulties in finding operating systems and software programs that communicate with each other, thereby simplifying training and implementation. Also, the maintenance of different software applications requires multiple sources of support, which increases costs. One jurisdiction, for example, uses three different configurations for student records, personnel management, and financial monitoring and reporting. At best, two of the systems are able to communicate with each other, but only in a limited number of functions.

Commitment to Technology in Education. Although expenditure levels vary considerably, technical and training support is being addressed in all jurisdictions. Up-front costs are high in some jurisdictions that are implementing new technology and software, but strong commitments have been made to these expenditures. Through joint planning with teachers, support staff and administrators, priorities are being established and achieved.

Networking and Communications Systems. These have been adopted in virtually all jurisdictions. Access to the Internet has improved dramatically in school offices, jurisdiction offices and classrooms. However, some rural jurisdictions are about to make decisions about satellite versus land-line to facilitate communication. Costs for the switch need to be carefully considered.

APPENDIX A
QUESTIONS FOR SCHOOL JURISDICTIONS AND SCHOOLS: SUMMARY

School jurisdictions and schools should answer the following questions and include statements about these topics in their technology plans.

Planning to Use Technology in Teaching and Learning

- ❑ Can we use current resources to achieve some of the provincial **learner outcomes in technology** before the provincial implementation of the ICT program of studies in September 2000? If so, which outcomes should we focus on?
- ❑ Can we manage the **total cost of acquiring, supporting and deploying the technology** used to achieve learner outcomes in technology and provide administrative and infrastructure support? (If we build it, can we support it?)
- ❑ Have we given equal consideration and weight to all three components of the total cost of ownership model (acquisition, support and deployment) in our vision, plans and actions?

The Cost of Technology

- ❑ What percentage of the total jurisdiction budget will we spend on **hardware and software**? (Should it be 2 per cent, as in the case study group for this research project?)
- ❑ How will we handle **decision making** about the deployment of technology (school-based budgeting, jurisdiction office policies, a combination of both)?
- ❑ Has our jurisdiction clearly defined "infrastructure" so that expenditures on **infrastructure** can be more accurately recorded?
- ❑ Can our jurisdiction link with others to develop procurement and service standards and provide adequate **connectivity levels** at affordable rates?
- ❑ How much will we spend on **security**? Should the amount be $2.25 to $3.00 per student—slightly above the current mean for the sample of Alberta jurisdictions studied in this research project?
- ❑ What steps will our jurisdiction take to increase **classroom access to the Internet** (which is essential for achieving provincial learner outcomes in technology)?
- ❑ What steps will our jurisdiction take to expand **access to the Internet for schools and jurisdiction offices** (something that all or most of the jurisdictions surveyed in this study consider essential)?
- ❑ How does our jurisdiction's **ratio of students to computers** compare with the means reported in this study and with the Management Information Reporting Schedule results from across the province? What should our targets be in this area, and how will we budget for the acquisition of additional hardware?
- ❑ What amount will our jurisdiction need to budget for in order to provide Internet **access** and cover **line charges**?
- ❑ How will we provide **technical support for Internet access**?

- ❑ Should our jurisdiction allocate **additional funds for purchasing computers as a learning resource**? If so, where will we find the necessary funds?
- ❑ Should our jurisdiction allocate **additional funds for purchasing computers as an administrative resource**? If so, how should this allocation compare to the expenditures on computers as a learning resource? Where will we find the necessary funds?

Technical Support

- ❑ How many **technical support staff** does our jurisdiction need in the schools? In the jurisdiction office? How much staff time should be allocated to each area in relation to the jurisdiction's priorities? Where will the funding come from to meet this goal?
- ❑ Has our jurisdiction planned how to cover the costs of providing **technical support for new hardware and software used in administration**? How much money should our jurisdiction allocate for technical support of administrative hardware and software? Should this amount be $25 to $30 per student, which is a typical level of funding in some jurisdictions in Alberta now?
- ❑ Do we have sufficient resources to respond quickly when **glitches in administrative hardware and software** occur? Or can we even anticipate and avoid them?
- ❑ Should we **contact other school jurisdictions and/or technology consultants** before making decisions about purchasing administrative hardware and software?

APPENDIX B
RELATED ALBERTA EDUCATION RESOURCES

Computer Network Security: Best Practices for Alberta School Jurisdictions (1999).

Developing A Three-Year Technology Integration Plan: A Resource for School Jurisdictions (1998).

FOIPP and Technology: Best Practices for Alberta School Jurisdictions (1999).

FOIPP and Technology Highlights: Best Practices for Alberta School Jurisdictions (1999).

Implementing and Managing Web Site Development in Education: Best Practices for Alberta School Jurisdictions (1999).

Managing Technology Funding: Best Practices for Alberta School Jurisdictions (1999).

Network Design: Best Practices for Alberta School Jurisdictions (1999).

On-Line Learning: Best Practices for Alberta School Jurisdictions (1999).

Preparing to Implement Learner Outcomes in Technology: Best Practices for Alberta School Jurisdictions (1999).

Professional Development for Teaching Technology Across the Curriculum: Best Practices for Alberta School Jurisdictions (1999).

Technology Implementation Review, Grande Yellowhead Regional Division No. 24 and Wolf Creek Regional Division No. 32: Best Practices and Key Learnings with Respect to Technology, Its Implementation and Management in Education (1997).